Apprenticeship and Industry Training

Structural Steel and Plate Fitter

Apprenticeship Course Outline

2600 (2000)

Government of Alberta

Apprenticeship and Industry Training

STRUCTURAL STEEL AND PLATE FITTER

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Care has been taken to acknowledge all sources and references in these materials. If there are any inadvertent omissions, please contact Alberta Learning, 10th floor, Commerce Place, Edmonton, Alberta, Canada, T5J 4L5.

Apprenticeship and Industry Training System

Apprenticeship is post-secondary education with a difference. It helps ensure Alberta has a steady supply of highly-skilled employees, the foundation of our economy's future health and competitiveness.

Apprentices in more than 50 trades and crafts spend between one and four years learning their trade - 80% of the time on-the-job under the supervision of a certified journeyman or qualified tradesperson. The balance of the program is technical training in the theory, skills and technologies of their trade.

To become certified journeymen, apprentices must learn theory and skills, and they must pass examinations. Requirements for certification - including the content and delivery of technical training - are developed and updated by the Alberta Apprenticeship and Industry Training Board (the Board) and a network of local and provincial industry committees.

The graduate of the Structural Steel and Plate Fitter apprenticeship training is a journeyman who will be able to:

- apply all applicable Codes and Regulations with reference to materials, its uses and safety.
- understand and apply the principles of drafting, how drawings originate, and how to correctly interpret the information given. The use of each type and the related work orders, materials lists, etc.
- work with shop fabrication, preparation, lay-out, assembly or repair of structural and miscellaneous components and vessel fabrication.
- perform a satisfactory operation with oxy-fuel or electric arc welding/cutting equipment in order to facilitate this work.
- be proficient in the safe use and maintenance of hand and power tools.
- be familiar with the work of other tradesmen in affiliated trades.
- perform the necessary functions required to fabricate, assemble vessel, structural and miscellaneous metal work, within the scope of a structural steel and/or vessel fabricating or manufacturing facility or shop.

While Alberta's apprenticeship system is supported by government, it is driven by industry (a term which includes both employers and employees). The Board steers the system, but the system relies on a network of local and provincial apprenticeship committees (LACs and PACs), representing the interests of each of more than 50 trades and crafts. Partners in the apprenticeship system play critical roles through the local and provincial committees within each trade.

Local Apprenticeship Committees (LAC)

Wherever there is activity in a trade, the Board can set up a LAC. The Board appoints equal numbers of employees and employers for terms of up to three years. The committee appoints a member as presiding officer. LACs:

- monitor the apprenticeship system, and the progress of apprentices in their trade, at the local level
- help settle certain kinds of issues between apprentices and their employers
- recommend improvements in apprenticeship training and certification to their trade's provincial apprenticeship committee
- make recommendations to the Board regarding the appointment of members to their trade's PAC.

Provincial Apprenticeship Committees (PAC)

The Board establishes a PAC for each trade and, based on PAC recommendations, appoints a presiding officer and equal numbers of employees and employers for terms of up to three years. Most PACs have nine members. PACs:

- identify the training needs and content for their trade
- recommend to the Board the standards for training and certification for their trade
- monitor the activities of local apprenticeship committees in their trade
- make recommendations to the Board about the designation of trades and occupations
- determine whether training of various kinds is equivalent to training provided in an apprenticeship program in the trade
- may participate in resolving any apprenticeship-related disputes between employers and employees

Structural Steel and Plate Fitter P.A.C. Members

Mr. D. Oborowsky	Edmonton	Presiding Officer
Mr. D. Stevens	Calgary	Employer
Mr. Z. Arar	Edmonton	Employer
Mr. P. Collins	Edmonton	Employer
Mr. J. Scheper	Edmonton	Employer
Mr. D. Deglow	Calgary	Employee
Mr. A. Thickett	Calgary	Employee
Mr. N. Denys	Edmonton	Employee
Mr. C. McGee	Edmonton	Employee

The Alberta Apprenticeship and Industry Training Board (Board)

The 13 members of the government appointed Board are aware of the training and certification needs of tradespeople and employers. Many Board members have previously served on an LAC or PAC. The Board:

- responds to industry's needs
- sets training and certification standards in all trades
- approves the technical training to be delivered by training establishments
- encourages the development of alternate methods of technical training delivery
- makes recommendations to the Minister of Alberta Learning about the designation of trades and occupations
- creates LACs, PACs, and appoints their members
- advises the Minister on the labour market's need for skilled and trained workers

Safety Education

Safe working procedures and conditions, accident prevention and the preservation of health are of primary importance in apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of employers and employees. Safe learning experiences and environments can be created by controlling the variables and behaviours that may contribute to or cause an accident or injury.

It is generally recognised that a safe attitude contributes to an accident free environment. Everyone will benefit as a result of a healthy safe attitude towards prevention of accidents.

A tradesperson may be exposed to more hazards than others in the work force. Therefore, tradespersons should be familiar and comply with the Occupational Health and Safety Act and Regulations respecting personal safety and the safety in the work place.

Legal and Administrative Aspects of Safety

Accident prevention and the provisions of safe working conditions are the responsibilities of an employer and employee.

Employer's Responsibilities:

The employer is responsible for:

- provision and maintenance of safety equipment.
- provision of protective devices and clothing.
- enforcement of safe working procedures.
- safeguards for machinery, equipment and tools.
- observance of all accident prevention regulations.
- training of employees in safe use and operation of equipment.

Employee's Responsibilities:

The employee is responsible for:

- working in accordance with the safety regulations pertaining to job environment.
- working in such a way as not to endanger themselves or fellow employees.

Technical Training Establishments

The Structural Steel and Plate Fitter apprenticeship training program is offered by Alberta Learning, Apprenticeship and Industry Training. Staff and facilities for delivering the program are supplied by Northern Alberta Institute of Technology at Souch Campus.

Procedures for Recommending Revisions to the Course Outline

This course outline has been prepared by the Industry Programs and Standards of the Apprenticeship and Industry Training in partnership with the Provincial Apprenticeship Committee for the trade.

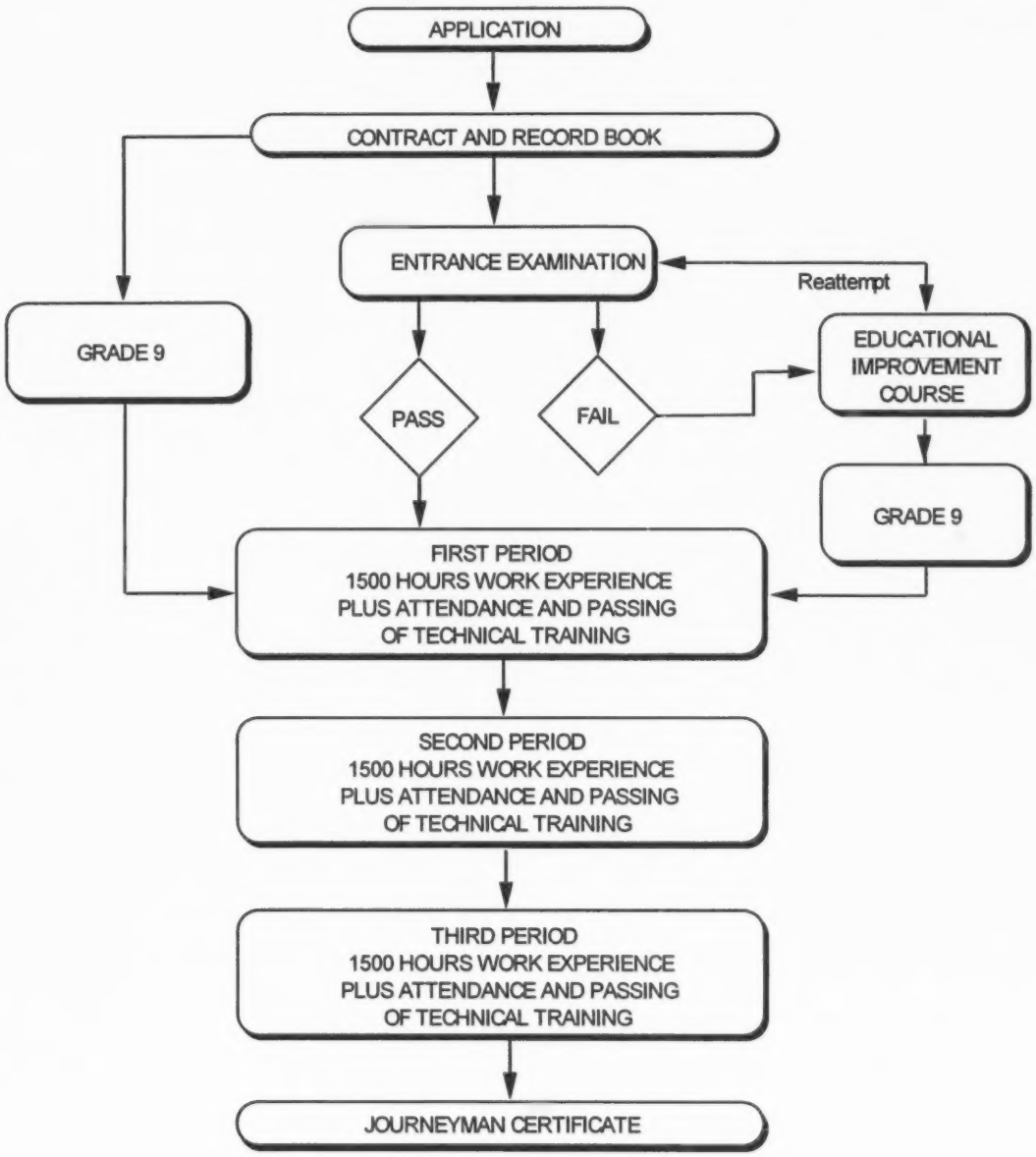
This course outline was approved on April 17, 2000 under the authority of the Alberta Apprenticeship and Industry Training Board on a recommendation from the Provincial Apprenticeship Committee. Valuable input is acknowledged from industry and the institutes.

Any concerned citizen or group in the Province of Alberta may make recommendations for change by writing to:

Apprenticeship and Industry Training
Industry Programs and Standards
10th floor, Commerce Place
10155 - 102 Street
Edmonton, AB T5J 4L5

It is requested that recommendations for change refer to specific areas and state references used. Recommendations received will be placed before regular meetings of the Provincial Apprenticeship Committee.

Apprenticeship Route Toward Certification



Accreditation

Any person who holds an Alberta Journeyman Certificate in any of the four trades, Boilermaker, Ironworker, or Structural Steel and Plate Fitter and wishes to serve an apprenticeship in either of the other two will be awarded first period time credits and will be required to write and pass that first period examination or attend all Technical Training.

Any apprentice serving an Alberta Apprenticeship in any of the three trades and wishes to transfer to any of the other two trades, will be awarded time credits only on the basis of one third of the time served as an apprentice in the original trade, and be required to attend all Technical Training.

Any person who holds an Alberta Journeyman Certificate in Welder or Structural Steel and Plate Fitter and wishes to serve an apprenticeship in the other trade will be awarded first period technical training credits and will be required to complete and pass those first period examinations or attend all Technical Training.

STRUCTURAL STEEL AND PLATE FITTER

TRAINING PROFILE

EMERGENCY FIRST AID AND CPR - PREREQUISITE TO OBTAINING JOURNEYMAN STATUS

***Completion of the first-aid course is the responsibility of the apprentice and must be completed prior to obtaining* Journeyman status.**

First Period
(8 Weeks 30 Hours Per Week - Total of 240 Hours)

SECTION ONE

MATERIAL HANDLING, TOOLS AND SAFETY — **52 Hours**

A	B	C
Safety — 6 Hours	Tools — 14 Hours	Rigging — 26 Hours

D
Hoisting and Material Handling — 6 Hours

SECTION TWO

LAYOUT, FITTING AND FABRICATION — **76 Hours**

A	B	C
Layout — 32 Hours	Flat Plate Layout, Templates and Material Mark-up — 10 Hours	Plate and Structural Steel Fabrication — 17 Hours

D
Basic Pressure Vessels — 17 Hours

SECTION THREE

DRAWING INTERPRETATION — **70 Hours**

A	B	C
Drawing Standards — 28 Hours	Material Designations — 18 Hours	Trade Mathematics — 24 Hours

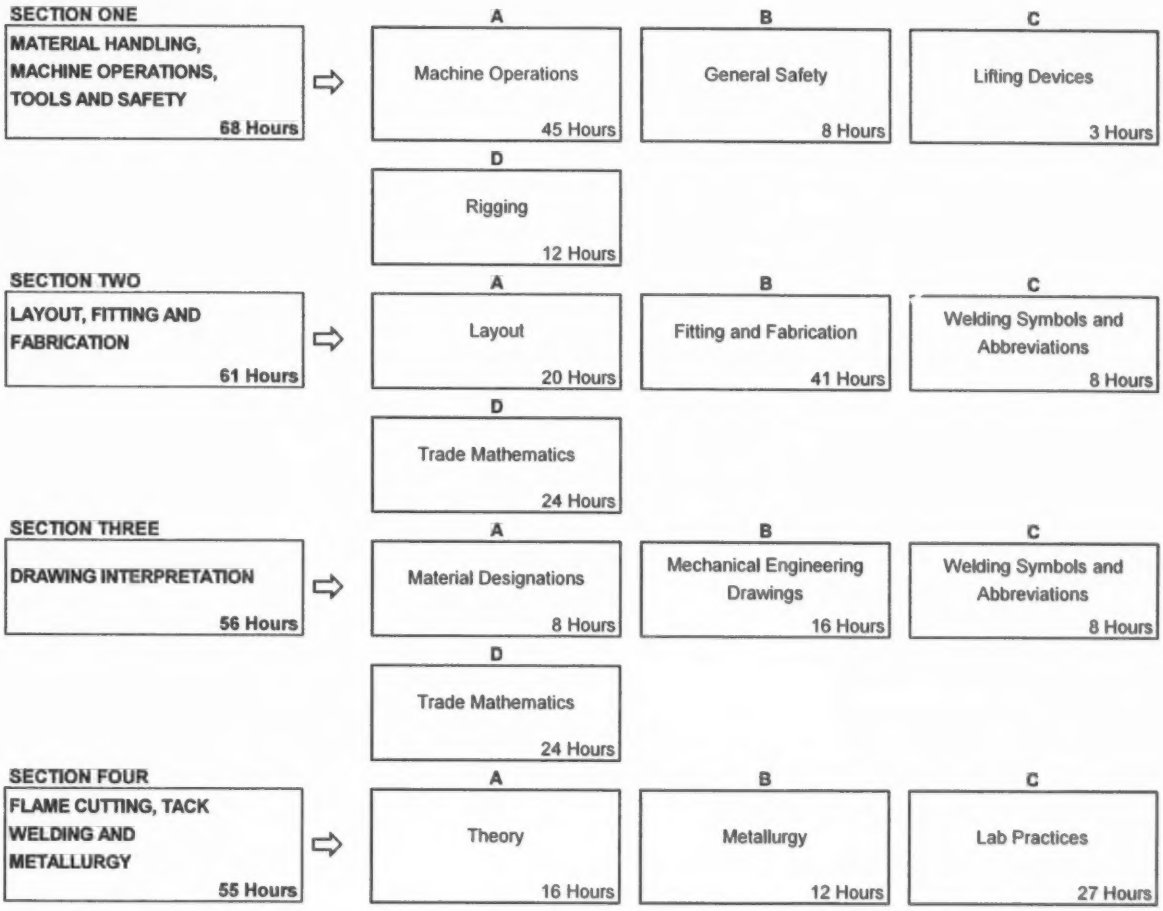
D	E	F
Text — # Hours	Text — # Hours	Text — # Hours

SECTION FOUR

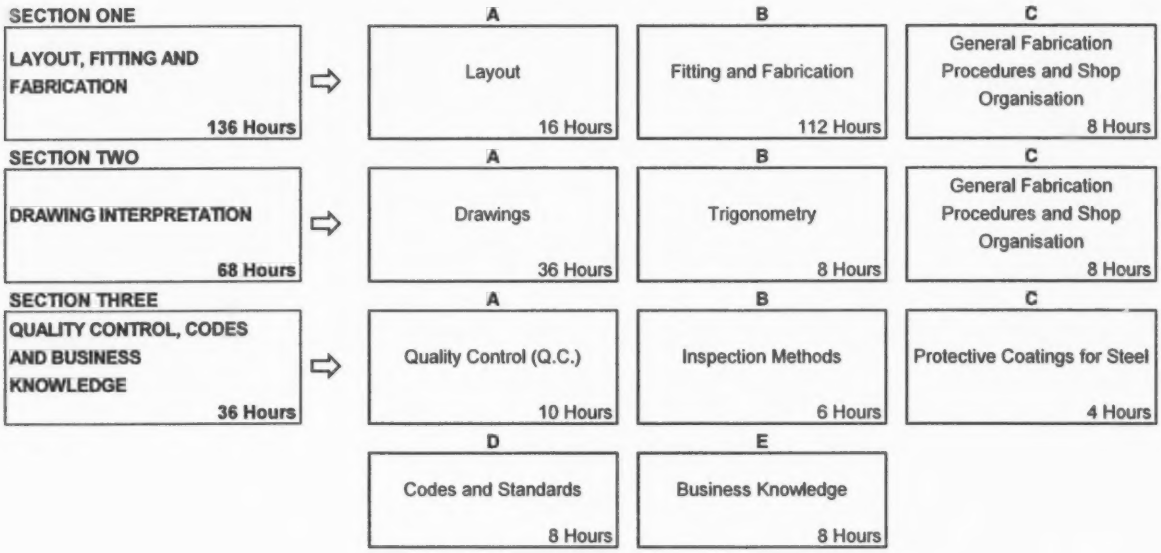
FLAME CUTTING, TACK WELDING AND METALLURGY — **42 Hours**

A	B	C
Flame Cutting — 8 Hours	Electric Arc Tack Welding — 8 Hours	Trade Mathematics — 24 Hours

Second Period
(8 Weeks 30 Hours Per Week - Total of 240 Hours)



Third Period
(8 Weeks 30 Hours Per Week - Total of 240 Hours)



NOTE: The hours stated are for guidance and should be adhered to as closely as possible. However, adjustments must be made for rate of apprentice learning, statutory holidays, registration and examinations for the training establishment and Apprenticeship and Industry Training.

FIRST PERIOD TECHNICAL TRAINING
STRUCTURAL STEEL AND PLATE FITTER TRADE
COURSE OUTLINE

Due to the nature of the work of the Structural Steel and Plate Fitter, it is imperative that safety be taught on a continuous basis throughout the entirety of this course.

Special emphasis should be placed on weak areas of theory and practical areas which are evident from progressive tests and examinations administered throughout the course. The time required for such examinations and tests, shall be allowed for in each area of instruction.

EMERGENCY FIRST AID AND CPR – PREREQUISITE TO OBTAINING JOURNEYMAN STATUS

Completion of the first-aid course is the responsibility of the apprentice and must be completed prior to obtaining Journeyman status.

Administer immediate on-the-spot first aid to persons with minor injuries and administer temporary emergency first aid to the more seriously injured, as deemed adequate until qualified medical personnel is available.

1.	Responsibilities and duties	1. Explain the responsibilities and duties of the First Aid person. 2. Explain the diagnoses for: a) respiratory failure b) burns c) body injury
2.	Applying artificial respiration	1. Explain the process of freeing the victim of breathing restrictions. 2. Explain the process of applying mouth-to-mouth respiration.
3.	Applying emergency treatment	1. Describe the procedure for: a) assessing injury b) moving the patient c) arresting bleeding d) completing Workers' Compensation Board forms
4.	Treating burns	1. Explain the methods of: a) quenching fire on a victim b) treating various burns
5.	Basic one-rescuer CPR	1. Explain what cardiovascular disease is and how it kills. 2. Explain how to recognise cardiovascular emergencies (severe angina, heart attack, cardiac arrest, etc.) and choking by their signs and symptoms. 3. Demonstrate how to respond effectively to cardiovascular and choking emergencies.

TOPICS	OBJECTIVES Upon successful completion of this unit the apprentice should be able to:
SECTION ONE:.....MATERIAL HANDLING, TOOLS AND SAFETY ..... 60 HOURS	
A. Safety.....6 Hours	
1. Causes of accidents	1. Describe the results of: a) inattention to work b) alcohol and drugs c) prescription drugs d) ineffective guarding e) inadequate housekeeping f) attitude g) improper use of tools h) unsuitable clothing i) excessive haste j) fire k) horse play l) lack of instruction 2. Describe methods of avoiding the causes of accidents. 3. Demonstrate respect for fellow workers. 4. Demonstrate safe acceptable housekeeping practices: a) describe the need for removal of i) drilling shavings ii) projections from walkways iii) oil spills or liquids iv) punchings v) electrode stub ends vi) burrs b) explain the purpose for rounding corners c) demonstrate safe maintenance procedures for tools d) explain proper storage and stacking of materials
2. Personal protective equipment	1. List and describe protective clothing and accessories such as: a) safety helmets b) safety shoes c) safety glasses d) types of clothing that are i) synthetic ii) leather iii) natural fibre e) proper hearing protection devices 2. Describe safety procedures for exposure to corrosives such as: a) showers b) eye wash stations

3. Electrical equipment	1. Describe tag out procedures such as: a) purpose of tag out b) methods of tag out c) misuses 2. Describe lockout procedures such as: a) principle and purpose of lockout b) methods of lockout
4. Introduction to W.H.M.I.S. (Workplace Hazardous Materials Information System)	1. Describe what W.H.M.I.S. is, it's rational and major elements. 2. Define what is meant by a W.H.M.I.S. label and distinguish between supplier and workplace labels and other means of identification.
Note: An introductory film is available regarding W.H.M.I.S. from Occupational Health and Safety.	3. Describe what is meant by the following classifications of: a) prohibited product b) restricted product c) controlled product 4. Explain what a Material Safety Data Sheet (MSDS) is, its purpose and limitations.
Note: No additional time will be allotted to this introduction, it will be incorporated with other safety items.	5. Describe the roles and responsibilities of employer, supplier and worker in the education of workers. 6. Other subject areas as deemed appropriate and deliverable by the training establishments.

B. Tools ..... 14 Hours

1. Grinders	1. Identify principal types of grinders and describe sizing. 2. Explain standard operations and safety features. 3. Describe and demonstrate grinding wheel truing, dressing and inspections. 4. Describe and demonstrate the method for dressing grind stones. 5. Describe and demonstrate the procedure for tool rest adjustments. 6. Describe and demonstrate the correct safe procedure for holding the grinder or the work. 7. Explain the relationship between grinder R.P.M. and grindstone and/or abrasive wheel ratings.
2. Layout and fitting tools	1. Identify and demonstrate the correct use of: a) tape measures b) squares c) scribes d) centre punches e) trammels f) chalk lines g) plumb bobs

h) levels
i) calipers
j) wrenches such as:
  i) sockets
  ii) spanners
  iii) box end wrenches
  iv) pipe wrenches
  v) Hexkey (Allen wrenches)
  vi) torque wrenches
k) hammers
l) hacksaws
m) files
n dividers
o) vises
p) compasses
q) steel piano wire
r) straight edges
s) micrometers

2. Describe and explain the uses of the tools required for layout.

3. Define safe practices for each.

3. Drilling and threading

1. Describe and perform the basic processes of drilling and hand thread making:
   a) use of a sensitive drill press for drilling small diameter holes (under ½")
   b) perform exercises in thread making, using taps and dies

2. Demonstrate correct procedures for:
   a) marking and centre punching
   b) securing the work piece

4. Air and electrical impact wrenches

1. List and describe the:
   a) various types of impact wrenches
   b) appropriate application for each type of impact wrench
   c) limitations for each type of impact wrench
   d) hazards encountered for each type of impact wrench
   e) appropriate use of universal joints

2. Explain the proper methods of care for each type of impact wrench.

5. Other pneumatic tools

1. List and recognise the various pneumatic tools as related to the Structural Steel and Plate Fitter trade:
   a) air grinders
   b) pneumatic chipping hammers

2. Define safe practices and explain proper methods of care for each type of pneumatic tool.

TOPIC	OBJECTIVES	FIRST PERIOD

C. Rigging ..... 26 Hours

1. Natural and synthetic fibre ropes	1. Identify and describe the various types and forms of natural and synthetic fibre ropes. 2. Describe care and maintenance of natural and synthetic fibre ropes. 3. Test natural and synthetic fibre ropes and knots for strength. 4. Identify and demonstrate the use of a: a) Bowline b) Spanish bowline c) clove hitch d) half hitch e) reef knot 5. Describe how proof loading works.
2. Slings (wire/synthetic rope, and chains) **Note: Safe Working Load (S.W.L.) and Working Load Limit (W.L.L.) are terms used interchangeably, depending on the manufacturer.**	1. Define proper procedures for slinging. 2. Define centre of gravity. 3. List and describe various types of slings. 4. Identify and explain the types of slings and chokers used for wire rope lifting. 5. Determine S.W.L. for various types of slings.
3. Lab practices (wire/synthetic rope and chains)	1. Demonstrate slings and hitches used for preparing and lifting material. 2. Tie knots and hitches and be aware of load limits. 3. Demonstrate proper use and location of chokers and slings on loads for lifting. 4. Demonstrate safe practices for loading/unloading and turning materials by: a) selecting correct rigging b) demonstrating safe rigging practices

D. Hoisting and Material Handling ..... 6 Hours

1. Cranes	1. List and describe safety aspects of: a) overhead cranes and their capacities b) other cranes 2. List and demonstrate signals used for: a) moving equipment b) hoisting 3. Describe methods and precautions in using hand signals.

TOPIC	OBJECTIVES	FIRST PERIOD

2. Fork lifts	1. Describe and demonstrate: a) proper uses of fork lifts b) safety precautions in use of fork lifts	
3. Handling equipment for process and fabrication	1. List and describe: a) transporters b) transfer tables c) conveyors	
4. Access structures	1. List and describe various types of scaffolding.	
	2. Describe correct and safe procedures for assembling and using scaffolding.	
	3. Describe: a) step ladders b) standard ladders c) extension ladders d) planking	
	4. Describe safety procedures for using ladders.	
	5. Demonstrate correct procedures for inspecting access structures.	
	6. List and describe safety rules for access structures.	

SECTION TWO: ..... LAYOUT, FITTING AND FABRICATION ..... 76 HOURS

A. Layout ..... 32 Hours

1. Drawing equipment	1. Identify and use basic drafting and shop layout tools: a) classroom -pencils -set squares -T-square -irregular curves -compass -eraser shields -protractor b) shop -chalk, layout blue, silver streak felt markers -centre and prick punches -rules -squares -soapstone -dividers -wrap around -trammels -tapes	
	2. Define and explain terms and symbols associated with drafting and layout.	
	3. Identify a circle and its basic components.	

4. Layout the following geometric constructions:
   a) parallel lines – tangent method
   b) perpendicular from points on and off the line
   c) transfer angles
   d) bisect lines, arcs and angles
   e) construct various polygons (divide a circle into a given number of parts)
   f) divide a line into a given number of parts using the draftsman and geometrical method
   g) find the centre of a circle
   h) construct a circle through 3 given points
   i) construct radii for right, obtuse and acute angles

5. Construct an ellipse using the trammel method.

6. Describe principles of parallel line development and identify patterns for a pipe and a square tube cut on an angle.

B. Flat Plate Layout, Templates and Material Mark-Up ..... 10 Hours

1. Define or describe various symbols and abbreviations used in material mark-up.

2. List and describe the purpose for various types of markers.

3. Describe mark-up procedure for flame cutting, drilling, punching, rolling (forming), breaking, shearing and match-marking.

4. List three types of templates and describe their purpose.

5. List types of materials used to make templates.

6. Record information required on templates.

7. Explain how to establish a square corner when laying out large rectangular or square shapes using:
   a) 3-4-5 method
   b) trammel method

8. Describe procedure for checking for square.

9. Describe the recommended procedure for efficient plate utilisation (nesting).

C. Plate and Structural Steel Fabrication ..... 17 Hours

1. Identify the basic components of a steel structure.

2. Define various terms associated with structural steel fabrication.

3. Identify and describe the purpose of specialised tooling.

4. Define three types of dimensioning:
   a) running dimensions
   b) group dimensions
   c) conventional or standard dimensions

5. Explain good fabrication practice.

6. Layout bevels for gussets and detail from shop drawings.

7. Explain how to layout a beam with regard to proper procedure and mark-up including:
   a) check for proper size
   b) check for allowable camber and sweep
   c) starting from top left
   d) direction marks
   e) piece number
   f) contract number
   g) top flange layout
   h) web layout
   i) bottom flange layout
   j) hole layout
   k) layout for detail
   l) mark-up for painting

D. Basic Pressure Vessels ..... 17 Hours

1. Relate C.S.A. definition of a pressure vessel.

2. Describe the two general classifications of pressure vessels.

3. Identify 5 types of unfired pressure vessels and explain their functions.

4. Identify and describe the components of a pressure vessel with regard to pressure parts, internal and external non-pressure parts. Identify three types of pressure vessel heads.

5. Name the government department involved in pressure vessel construction and state their authority.

6. Describe the abbreviations A.S.M.E. and A.S.T.M.

7. List three A.S.M.E. sections which deal with pressure vessels and describe the purpose of each.

8. List four types of low carbon steel plate used in pressure vessel construction. Explain their application.

9. Determine plate lengths for cylinders and mark-up procedure for rolling.

10. Define grain direction and how it relates to rolling of cylinders.

11. Explain how to properly determine arc lengths for layout of centrelines, nozzles, longitudinal seams, etc.

12. Explain how code affects preparation of material, fit-up of seams, required marking and testing.

SECTION THREE: ..... DRAWING INTERPRETATION ..... 70 HOURS

The instruction given under this section shall be kept to a working knowledge and ability and under no circumstances approach the level of a technical draftsman. Both metric and imperial measures shall be used.

A. Drawing Standards ..... 28 Hours

1. The graphic language	1. Interpret the introduction.
2. Drafting standards	1. Describe and compare A.S.A. and I.S.O. standards. 2. Describe and explain the general layout of a drawing: a) title block b) bill of materials c) specifications chart d) general and specific notes e) reference drawings f) revision chart g) nozzle schedule and welding details 3. Describe the alphabet of lines and correct use of them. 4. Describe and explain the method of folding, care and storage of drawings.
3. Projections	1. List and describe the various types of: a) orthographic projections b) multiview projections c) third angle projections 2. Describe and illustrate orthographic projections regarding: a) top view plan b) bottom view c) front view d) right and left side views e) back view f) plans and elevations g) types of special views 3. Describe and illustrate isometric projection.
4. Dimensioning	1. Define and describe the: a) size description b) scale of drawing c) techniques of dimensioning d) lines used for dimensioning i) baseline or datum ii) conventional iii) group

e) placement of dimensional and extension lines
f) arrowheads and leaders
g) fractional and decimal dimensions
h) direction of dimension figures
i) dimensioning arcs, angles, fillets and rounds
j) surface finish marks and symbols
k) tolerances of shop processes
l) tolerances of angles

5. Sketching and shape description

1. Freehand sketch simple parts such as:
   a) bolts
   b) rectangular or square shapes
   c) round and oblong shapes

2. Sketch perspective and orthographic multiviews using the following techniques of lines and their identification such as:
   a) views of objects - 3 principle dimensions (width, depth and height)
   b) revolving the objects, spacing between views
   c) the six views - top, front, bottom, rear, left and right sides
   d) orientation of front view - choice of operational position as front
   e) two view drawings
   f) one view drawings - for simple objects
   g) hidden lines - correct and incorrect practices
   h) centre lines - axis of symmetrical objects
   i) alignment of views - standard A.S.A. application

6. Reading a drawing

1. Identify surfaces of a project.

2. Use the numbering system for all points.

3. Identify and describe:
   a) normal surfaces and edges
   b) inclined surfaces and edges
   c) oblique surfaces and edges
   d) parallel edges
   e) angles
   f) curved surface
   g) intersections of cylinders
   h) intersections of tangents

4. Describe and demonstrate proper representation of holes.

5. Identify and describe right hand and left hand parts.

6. Solve multiview projection problems.

7. Identify and describe partial, full sectional and auxiliary views.

7. Interpreting drawings

1. Identify appropriate size and length of materials according to cutting or material bills.

2. Do a simple material take-off from a structural print.

3. Interpret simple structural, vessel and tank drawings.

8. Design and working drawings

1. List and/or describe:
   a) layout and assembly drawings

b) detail drawings and number of details per sheet
c) title strip
d) bill of material and drawing numbers to
   i) define the various types of material bills
   ii) define the parts of a material bill
   iii) demonstrate the ability to interpret a material bill
   iv) develop a material bill from a structural drawing
   v) explain purpose of special notes
e) methods of checking and drawing revisions
f) computer drawings

2. Demonstrate methods to practice interpretation and problem solving on a variety of structural and plate (vessel) type working drawings.

B. Material Designations ..... 18 Hours

1. Structural steel

1. List and describe:
   a) various common structural shapes
   b) old and new designations
   c) the numbering system used to identify structural shapes
   d) methods used for dimensioning various structural shapes
2. Calculate various weights of structural shapes.
3. Discuss:
   a) bar sized shapes
   b) cold and hot rolled steel

2. Plate and sheet stock

1. Explain the difference between plate and sheet steel.
2. Discuss the difference between structural quality steel and pressure vessel steel.
3. Describe plate designation format method of dimensioning and weight.
4. Recognise sheet and plate size according to thickness.

3. Grating

1. Identify grating.
2. State some uses for grating.
3. Describe the nomenclature of grating.
4. Explain the method used to describe how grating is sized and ordered.

4. H.S.S. (Hollow Structural Sections), pipe and tube

1. Recognise the three H.S.S. shapes.
2. Describe how H.S.S. is:
   a) manufactured
   b) dimensioned and ordered

3. Explain that H.S.S. is for structural use only.
4. Display a pipe and relate that it can be used for structural and mechanical applications.
5. Describe O.D., I.D. and wall thickness as three significant dimensions for pipe.
6. Describe the methods of manufacturing pipe. (seamless and butt welded)
7. Define the terms:
   a) nominal pipe size and range
   b) pipe schedules and list the three most common
8. Observe pipe chart and compare the actual O.D. to the N.P.S.
9. Define the marking system used for pipe.

5. Pipe fittings

1. Describe what a pipe fitting is.
2. Define the purpose of pipe fittings.
3. Describe two ways to identify pipe fittings.
4. List and describe or explain uses for various fittings such as:
   i) nozzles
   ii) slip-ons
   iii) couplings
   iv) tees
   v) elbows
   vi) flanges and blind flanges
   vii) welding necks
   viii) plugs
   ix) valves
   x) special pressure vessel fittings
5. State how pipe fittings are designated as to their size and pressure rating.
6. Identify three methods of joining pipe fittings to pipe.
7. Describe the marking system used to identify pipe fittings.

6. Structural and vessel fasteners

1. Identify types of fasteners most commonly used in structural and vessel industries:
   a) bolts, studs and screws
   b) American Standard bolts and nuts
   c) locknuts and locking devices
   d) keys, pins and rivets
   e) compression, torsion and flat springs
2. Describe the difference between a bolt and stud-bolt.
3. Describe specifications for bolts, stud-bolts and nuts.
4. Discuss material grading system S.A.E. and A.S.T.M.

5. Identify bolt, stud and nut marking system for Type 1 only Grades A307, A325, A490, A194 and B7.
6. Identify thread classification systems for metric and imperial threads.
7. Discuss flat and bevel washers.
8. Describe Class 2A and 2B thread engagements.

C. Trade Mathematics ..... 24 Hours

The mathematics delivered under this section shall maintain a level applicable to the tradesman, and have a definite relationship to functions experienced in the trade of Structural Steel and Plate Fitter.

1.	Whole number and fractions	1. Solve problems using whole numbers and fractions in: a) addition b) subtraction c) multiplication d) division
2.	Decimals	1. Solve problems using decimal numbers in: a) addition b) subtraction c) multiplication d) division 2. Change decimal numbers to fractions and vice versa.
3.	Percentages, ratio and proportion	1. Calculate percentage and ratio using: a) whole numbers b) decimal c) fractions 2. Solve problems involving direct proportion. 3. Calculate scale ratio on drawings.
4.	Perimeters and areas	1. Calculate perimeters and areas of: a) squares b) rectangles c) circles d) parallelograms e) irregular shapes
5.	Volumes	1. Calculate volumes of: a) square containers b) rectangular containers c) cylindrical containers
6.	Conversions	1. Convert: a) feet to inches and vice versa b) square inches to square feet and vice versa

c) cubic inches to cubic feet and vice versa
d) U.S. gallons to imperial gallons
e) Fahrenheit to Celsius and vice versa

7. Imperial and metric
1. Calculate:
a) areas
b) volumes
c) linear measurements
d) weights

8. Calculator
1. Demonstrate competence in using a calculator.

SECTION FOUR: ..... FLAME CUTTING, TACK WELDING AND METALLURGY ..... 42 HOURS

The instruction under this section **shall not** be to the level of a proficient and skilled Welder. The intent is to train the apprentice to a level where he may operate the required equipment in a safe manner, and perform such operations of flame cutting and tack welding as to make temporary attachment of component parts, prior to the finish welding required by a certified Welder.

A. Flame Cutting ..... 8 Hours

1. Oxyacetylene equipment
a) cylinders
1. Describe the construction of the oxygen and acetylene cylinders.
2. Describe the different sizes of cylinders.
3. Explain the procedure for handling, transporting and storing cylinders.
4. State the procedure for handling faulty cylinders.
5. Explain the procedure for filling cylinders.
6. Explain the construction and purpose of a manifold system.

b) regulators
1. Describe the purpose of a regulator.
2. Describe the basic construction and pressures involved for a single stage and double stage regulator.

c) hoses
1. Explain the construction of hoses.
2. Identify hoses and fittings.
3. Explain the C.S.A. specifications of hoses.
4. State the procedure for the repair and maintenance of hoses.

d) tips
1. Describe the design and construction of cutting tips.
2. Explain the operating principles of a cutting tip.
3. Describe and demonstrate:
a) care and maintenance of tips
b) correct selection of tips

TOPIC	OBJECTIVES	FIRST PERIOD
e) fire prevention and controls	1. Identify the types of fire extinguishers available and where used.	
	2. Define hazardous areas in construction.	
	3. Describe how to prevent fires.	
2. Setting-up	1. Explain and demonstrate the correct placement and securing of cylinders.	
	2. Explain and demonstrate the clearing and checking of cylinder valves.	
	3. Attach regulators safely and correctly.	
	4. Attach hoses and explain reason for cleaning new hoses.	
	5. Attach correctly the barrel and tip.	
	6. Explain the correct procedure in checking for leaks.	
	7. Check to assure that the regulators were not used for any other purpose than for what they were intended.	
3. Pressures and flame adjustments	1. Explain and demonstrate the correct regulator adjustments and balancing pressures.	
	2. List the reasons for backfires and flashbacks.	
	3. Define flame propagation.	
	4. Ignite the torch using the recommended procedure and accessories.	
	5. Explain and demonstrate the different types of flames and uses.	
	6. List and demonstrate the acceptable shutting down procedure.	
B. Electric Arc Tack Welding		**8 Hours**
1. Basic electricity	1. Define open circuit voltage.	
	2. Define arc voltage.	
	3. Define alternating current and direct current.	
	4. Define resistance.	
	5. Explain duty cycle.	
	6. Define electrode positive and electrode negative polarity.	
	7. Explain the heat distribution using electrode positive or electrode negative polarity.	
	8. Explain voltage loss.	

TOPIC	OBJECTIVES	FIRST PERIOD
2. Arc welding machines	1. Describe the basic components and operation of an alternating current transformer. 2. Describe the basic components and operation of an A.C. - D.C. rectifier. 3. Describe the basic component and operations of an A.C. and D.C. generator. 4. List the advantages and disadvantages of the various types of welding machines.	
3. Selecting and installing welding machines	1. Explain the reasons for selecting a welding machine for a specific task. 2. Explain the consideration to be taken when installing a welding machine in a shop environment.	
4. Maintenance of welding machines	1. Explain the day to day maintenance required for welding machines.	
5. Accessories for welding machines	1. Describe welding cable construction. 2. Explain welding cable sizing. 3. Describe the various types of electrode holders and explain the maintenance required. 4. Describe: a) cable lugs b) quick connectors c) ground clamps	
6. Machine controls	1. Describe the controls on a welding machine. 2. Explain the arc characteristics in relation to the different voltage and amperage settings.	
7. Mild steel arc welding electrodes	1. Explain the numerical definitions of electrodes. 2. List the functions of coating. 3. List the functions of the slag. 4. Explain the effects of alloy additions to the coating. 5. Explain static and dynamic loading.	
8. Safety	1. Describe and wear proper welding apparel. 2. Describe and wear proper welding goggles. 3. Describe the process for fireproofing materials. 4. State the use of protective screens. 5. Describe a welding helmet and illustrate the proper placement of lenses.	

6. Describe and illustrate safe housekeeping practices.
7. List the rays involved with welding and the effects associated with these rays.
8. Describe the responsibilities and procedures to protect oneself and the general public from harmful rays.
9. List the reasons for grounding of electrical equipment.

C. Metallurgy..... 10 Hours

1. Physical and mechanical properties of metals	1. Define and describe: a) density b) brittleness c) ductility d) elasticity e) hardness f) thermal and electrical conductivity g) malleability h) tensile strength i) toughness j) coefficient of expansion k) melting and boiling points
2. Manufacturers of ferrous metals	1. Describe: a) pig iron, raw materials and palletising process b) manufacture of pig iron and blast furnace c) manufacture of cast iron, types and cupola furnace d) manufacture of steel, open hearth process, basic oxygen process, electric furnace and vacuum process
3. Steel processing	1. Describe: a) ingots, slabs and casting b) rolling, blooms and billets c) hot and cold rolled steel d) other methods of forming ferrous and non-ferrous products
4. Chemical composition of steel	1. Describe: a) effects of elements in steel b) carbon, manganese and silicon c) sulfur and phosphorus
5. Classification of steel	1. Describe: a) carbon and alloy steels b) steel code classifying systems such as S.A.E. and A.I.S.I. c) A.S.T.M. and C.S.A. designations of structural and pressure vessel steels

TOPIC	OBJECTIVES	FIRST PERIOD

D. Lab Practices ..... 16 Hours

1. Tack welding: a) stringer beads b) lap welds c) butt welds d) corner welds e) tee welds f) tack welds	1. Practice: a) striking and maintaining an arc b) running practice beads c) making tack welds d) tack welding with GMAW equipment 2. Practice stringer beads on available mild steel in the flat position using E6010 and E7018 filler material. 3. Demonstrate the ability to tack weld lap joints on 1/4" (6 mm) mild steel in the flat, vertical and horizontal positions using E6010 and E7018 filler materials. 4. Demonstrate acceptable tack welding procedures to prevent distortion for all the joints.
2. Flame cutting a) operation of equipment	1. Demonstrate safe set-up procedures. 2. Demonstrate the correct regulator adjustments and balancing pressures.
b) manual cutting	1. Perform straight line and bevel cutting on plate steel. 2. Perform cuts on various structural steel shapes.
c) semi-automatic cutting	1. Demonstrate the correct and safe operation of a radiograph.

SECOND PERIOD TECHNICAL TRAINING
STRUCTURAL STEEL AND PLATE FITTER TRADE
COURSE OUTLINE

Due to the nature of the work of the Structural Steel and Plate Fitter, it is imperative that safety be taught on a continuous basis throughout the entirety of this course.

Special emphasis should be placed on weak areas of theory and practical areas which are evident from progressive tests and examinations administered throughout the course. The time required for such examinations and tests, shall be allowed for in each area of instruction.

TOPICS	OBJECTIVES **Upon successful completion of this unit the apprentice should be able to:**
SECTION ONE:..... MATERIAL HANDLING, MACHINE OPERATIONS, TOOLS AND SAFETY..... 68 HOURS	
A. Machine Operations .....45 Hours	
1. Drilling machines	1. Explain and demonstrate the proper and safe use of: a) twist drills b) reamers c) countersinks d) hole saws e) machine taps
	2. Explain and describe the principal types of drilling machines and sizing: a) floor and bench drill presses b) portable magnetic drill presses
	3. Explain the standard operations and drill work holding devices such as: a) drill vises b) drill jigs c) clamps
	4. Explain and describe the systems of drill sizes, drill geometry and sharpening.
	5. Explain the correct drilling speeds, feeds and cutting fluids.
	6. Explain and describe drilling problems.
	7. Describe and demonstrate proper maintenance and safety in assigned drilling operations.
	8. List and describe: a) drill sizes b) drill speeds and feeds c) materials and cutting fluids
	9. Perform exercises in drill sharpening and hole drilling.
	10. Describe reamers and operations.
2. Power saws	1. Identify principal types of power saws and describe sizing.

	2. Explain standard operations and work holding devices.
	3. Explain the correct cutting speeds, feeds and cutting fluids.
	4. Demonstrate correct blade selection and guide rollers adjustment for band saws.
	5. Demonstrate proper maintenance and safety when completing assigned projects.
3. Metal fabrication equipment: a) power press brakes b) power plate rollers c) power benders d) ironworker e) punches f) shears	1. Identify principal types of metal fabrication equipment and describe sizing.
	2. Describe and explain the design and construction limitations.
	3. Explain standard operations, punch and work holding devices.
	4. Describe the system of punch sizing and tolerances.
	5. Identify and describe strippers, lubrication and determine capacities.
	6. Describe rake and knife clearances.
	7. Describe shear feeding and automatic cycling.
	8. Identify and explain hold-downs and gages, punching and shearing problems.
	9. Explain and demonstrate correct metal forming theory and practices.
	10. Demonstrate correct die selection and mounting procedures.
	11. Demonstrate proper operations, maintenance and safety when completing assigned projects.
4. Threading	1. Describe taps and dies.
	2. List and describe: a) tap styles and proper uses b) common threads and sizes
	3. Use micrometer for verifying thread sizes.
	4. Identify and describe the types of power threaders such as: a) stationary b) portable
	5. Describe the standard operations for: a) external threading b) internal threading
	6. Describe the recommended tapping speeds and cutting fluids used for various metals.
	7. Describe tapping operations using drilling machines.
	8. Describe and identify tap and die designations.

TOPIC		OBJECTIVES	SECOND PERIOD
		9. Demonstrate proper maintenance and safety when completing assigned projects.	
	5. Grinders	1. List and describe: a) types of grindstones and abrasive wheels b) types of bonds c) safety procedures	
		2. Identify and describe proper grinding wheels and types of abrasives for specific tasks.	
		3. Describe and demonstrate the recommended grinding speeds and feeds.	
		4. Demonstrate proper maintenance and safety when completing assigned projects.	
	6. Special equipment	1. Explain the uses and advantages of: a) power welding positioners and rotators b) portable power hydraulic tube and structural steel benders c) electrical and pneumatic powered tube cold rolling and forming equipment and accessories d) universal milling, portable milling and scarfing machines e) opto-electronic f) plasma-arc cutting machine g) hydraulic tube puller and air powered tube reamer	
		2. Recognise operation of and demonstrate: a) abrasive stationary and portable cut-off equipment b) portable magnetic drill presses and power saws c) portable power nibblers	
		3. Demonstrate proper maintenance and safety when completing assigned projects.	
B.	**General Safety**		**8 Hours**
	1. Safety equipment	1. Describe and demonstrate the correct use of: a) goggles b) fall arrest systems c) oxygen masks d) fume exhausters e) dust filters and masks f) fire fighting equipment	
	2. Accident prevention	1. List and describe the causes and prevention of potential electrical accident: a) identify the ground wire b) describe the proper grounding procedures	
		2. List explosive and poisonous vapours related to the work environment.	
	3. Workers' Compensation Board	1. Select and complete the correct accident forms as required by W.C.B.	

TOPIC	OBJECTIVES	SECOND PERIOD
4. Health and safety	1. Locate and interpret applicable Occupational Health and Safety Regulations. 2. Discuss "Metal Fabricating Health and Safety Association" (M.F.H.S.A.).	
C. Lifting Devices		**3 Hours**
1. Basic lifting devices	1. Identify and explain the safe operation of: a) air hoists b) chain falls (block and tackle) c) come-alongs d) tirfors	
D. Rigging		**12 Hours**
1. Wire rope and chains	1. Identify characteristics and types of construction of wire rope. 2. Describe identification or marking system for chains. 3. Describe types of lays and material grades for wire rope. 4. Explain wire rope classification and proper handling procedures.	
2. Care and handling **Note: Safe Working Load (S.W.L.) and Working Load Limit (W.L.L.) are terms used interchangeably, depending on the manufacturer.**	1. Describe proper maintenance, storage, safety and care of wire rope and chains. 2. Identify types of wire rope/chains and construction. 3. Identify safe work loads (S.W.L.) for wire rope and chains. 4. Explain the uses, care, storage and handling of wire rope and chains. 5. Explain the reason for safe work loads.	
3. Fittings	1. List and describe uses of: a) clips and lifting lugs b) sockets c) thimbles d) rings e) shackles f) hooks	
4. Equipment aids	1. Identify and describe the uses for: a) a spreader bar b) an equalising beam c) piling and blocking d) plate clamps e) hydraulic and jack screws 2. Define and describe procedures involved in: a) lifting various weights b) how the various materials should be handled	

SECTION TWO: ..... LAYOUT, FITTING AND FABRICATION ..... 61 HOURS

A. Layout ..... 20 Hours

1. Apply principles of parallel line development to layout stretch-out templates for:
   a) mitred elbows
   b) branch and headers (equal and unequal diameter)
2. Define the term "radial line development", and apply its principles to layout stretch-out templates for cones, pyramids, and frustums of cones and pyramids.
3. Describe how material thickness relates to stretch-out templates.
4. Apply bend allowance and mean diameter to develop stretch-out templates.
5. Define and explain the principles of triangulation and identify the shape of objects to which this type of development applies.

B. Fitting and Fabrication ..... 41 Hours

1. Vessel fitting

1. Name the parts of skirts, saddles and davits.
2. Explain how to calculate Hi-Low required for fit-up of cylindrical seams.
3. Explain maximum out of roundness for cylinders allowed by code.
4. List and describe various plate fitting tools and state their advantages and disadvantages.
5. Describe how to fit cylinders of various thicknesses and diameters.
6. Describe proper procedure to fit nozzles into cylinders of various thicknesses and diameters.
7. Relate proper layout procedure for large diameter holes in cylinders.
8. Describe techniques and procedures involved in preparation and completion of a hydrostatic test.

2. Pipe, tube and plate bending

1. List and describe four methods of bending pipe and tube.
2. State suggested minimum bend radius for standard and heavy wall pipe.
3. Define the terms "radius of bend" and "springback".
4. Explain proper procedure for bending seamed pipe.
5. Calculate straight lengths of pipe required for ninety degree bends.

		6. Explain how to determine proper press brake tooling for plate bending operations.
		7. Relate plate grain direction to the bending/forming process.
		8. Determine bend allowance for mild steel plate less than 1/2" thick. Layout plate for bending.
		9. Explain how to reduce cracking of plate while bending.
3.	Stair fabrication	1. Define common stair terminology.
		2. Describe standard safety requirements.
		3. State how Alberta Building Code Regulations and customer design criteria affect stair design.
		4. Identify common steel stair material.
		5. State common stair design rules.
		6. State 3 stair calculation rules.
		7. Describe field measurement procedure.
		8. Calculate rise, run, step length and stringer length given total rise and total run.
		9. Layout a pair of stringers from a shop drawing.
4.	Miscellaneous steel (ladders, platforms and railings)	1. Describe principle types and sizing.
		2. Describe basic components and appropriate material selection.
		3. Describe methods of layout and assembly.
		4. Describe proper procedure for fabrication and shipping.
		5. Describe proper finishing, surface protection and anchoring procedures following standard safety requirements.
5.	Welded and bolted structural connections	1. Identify and describe: a) column bases b) column splices c) seated beam connections d) end plate connections e) double angle beam connections f) bracing systems and their connections g) skewed and knee brace connections h) combined details of right and left hand (as shown and opposite)

SECTION THREE: ..... DRAWING INTERPRETATION ..... 56 HOURS

Though specific characteristics of this section may be duplicated in relation to structural and vessel fabrication, the ratio should be directed to a 50/50 proportion as far as practically feasible. Both imperial and metric systems should be applied.

A. Material Designations ..... 8 Hours

1. Structural steel	1.	Discuss G40.21 M standard.
	2.	Discuss camber and sweep tolerances.
	3.	Discuss mill tolerance.
	4.	Explain methods of ordering structural steels.
2. Plate and sheet stock	1.	Describe purpose of heat code, plate grade and transferability.
	2.	Discuss plate designation for A.S.T.M./A.S.M.E., A.I.S.I. and C.S.A.
	3.	Describe clad steel.
3. Expanded mesh	1.	Identify expanded mesh.
	2.	State some uses for expanded mesh.
	3.	Describe the nomenclature of expanded mesh.
	4.	Explain the method used to describe how expanded mesh is sized and ordered.
4. H.S.S. (Hollow Structural Sections), pipe and tube	1.	Describe various pipe grades and their applications (A-53, A-106).
	2.	Describe the abbreviation W.O.G.
	3.	Describe the standard tapered pipe thread and thread engagement.
	4.	Describe the difference between structural tube and mechanical tubing.
	5.	Describe how tube and tubing is sized.
5. Pipe fittings	1.	Identification of pipe fittings.
6. Structural and vessel fasteners	1.	Identify bolt, stud and nut marking systems.
	2.	Identify other stud markings.
	3.	Calculate bolt and stud lengths for various grips.
	4.	Discuss methods of tightening and determining torque.

B. Mechanical Engineering Drawings ..... 16 Hours

1. Intermediate drawings	1. Read and interpret intermediate drawings involving fabrication detail and assemblies of typical steel structures, tanks, pressure vessels and components for: a) composite steel frames and supports b) structural details for buildings and bridges c) designs of structural members and assemblies d) storage tanks and detailed components e) pressure vessels and detailed components f) fume ductwork and detailed components g) specifications 2. Describe and demonstrate ability to estimate materials and take-off.

C. Welding Symbols and Abbreviations ..... 8 Hours

1. Explain the purpose of weld symbols.
2. Define a:
   a) weld symbol
   b) welding symbol
3. Interpret elementary:
   a) weld symbols
   b) welding symbols
4. Identify parts of the welding symbols.
5. Identify and interpret sizes and types of fillet welds.
6. Identify and interpret groove welds.
7. Identify all abbreviations generally used on structural, vessels and piping drawings.
8. Demonstrate ability to interpret all symbols used for welded, bolted or pinned connections.

D. Trade Mathematics ..... 24 Hours

Due to the nature of application in the trade of Structural Steel and Plate Fitter, the mathematics given under this section shall be flexible and applied to the trade of Structural Steel and Plate Fitter, both imperial and metric systems should be applied.

1. Linear measurement	1. Demonstrate ability to solve linear measurement problems using: a) fractions b) decimals c) conversions between decimal and fractions
2. Area	1. Solve area measurement problems using:

a) unit of area measure
b) conversions of area units
c) plane figures (rectangle, circle, etc.)

3. Stretch-out calculations
   1. Calculate:
      a) quantities of material
      b) stretch-out for cylinders
      c) arc lengths
      d) bend allowance

4. Volume
   1. Solve volume measurement problems using:
      a) units of volume measurement
      b) conversions of volume units
      c) volume figures (cube, cone, etc.)

5. Ratios and proportions
   1. Calculate similar triangles.
   2. Calculate slopes.
   3. Convert drawing scale to working ratio and job line dimensions.
   4. Calculate problems involving indirect proportion.

6. Percentages
   1. Calculate percentages as in:
      a) simple interest
      b) discounts, including successive discounts

SECTION FOUR: ..... FLAME CUTTING, TACK WELDING AND METALLURGY ..... 55 HOURS

The instruction under this section **shall not** be to the level of a proficient and skilled Welder. The intent is to train the apprentice to a level where he may operate the required equipment in a safe manner, and perform such operations of flame cutting and tack welding as to make temporary attachment of component parts, prior to the finish welding required by a certified Welder.

A. Theory ..... 16 Hours

1. Types of welds
   1. Identify and explain the application of:
      a) fillet welds
      b) groove welds
      c) plug or slot welds
      d) correct location of tack welds
   2. Explain how the basic welds apply to the various types of joints.

2. Basic joints
   1. Identify and explain the application of:
      a) butt joint
      b) lap joint
      c) corner joint
      d) edge joint
      e) tee joint
   2. Describe the variations and limitations of the five basic joints.

TOPIC	OBJECTIVES	SECOND PERIOD

3.	Weld faults and notching effects	1. Explain the causes of dimensional defects. 2. Identify and explain the results of: a) notch effect b) slag inclusions c) porosity d) lack of fusion
4.	Stud welding	1. Describe the equipment used for stud welding. 2. Explain the correct operating procedures. 3. List the uses and advantages of stud welding.
5.	FCAW/SAW	1. Describe the equipment required. 2. Explain the correct operating procedures. 3. List the uses and advantages of each.
6.	Gas Metal Arc Welding (GMAW)	1. Recognise basic equipment and operation. 2. Describe and define GMAW welding. 3. Describe and demonstrate setting up of GMAW equipment. 4. Explain the safe operation of GMAW equipment.
7.	Air arc gouging	1. Describe the equipment required for air arc gouging. 2. Explain the correct operating procedures. 3. List the uses and advantages of air arc gouging.
8.	Other processes	1. Describe and demonstrate the correct and safe operation of electronic tracers inclusive of plasma-arc processes. 2. Describe other cutting processes.

B. Metallurgy.....12 Hours

1.	Identification of steels	1. Describe: a) spark test for low carbon steel, high carbon steel, white and grey cast iron, and stainless steel b) fracture and chip test c) simple bend or file test d) hardness test e) colour, weight and conductivity
2.	Heat treating processes	1. List and explain rules governing pre and post heating procedures.

		2. Describe the procedures for: a) stress relieving and tempering steels b) annealing and normalising c) quench hardening
		3. Describe and demonstrate flame hardening, heat treatment and sharpening of punching and chipping tools (including fabrication of a punch or chisel).
		4. Describe the effects of quenching on steel hardness measured in Brinnell or Rockwell scales.
		5. Describe the influence to the micro structures of steel from the effects of cutting or welding processes.
3.	Weld ability of steels	1. Describe the effects that elements in steel have on welding and cutting processes.
		2. State reasons for limitations and recommended procedures.
4.	Hot and cold working	1. Explain the effects of hot and cold working on the grain structure in metal and describe procedures to remove these effects such as: a) cold hammering b) rolling c) drawing d) pressing
		2. Describe changes in mechanical properties when hot and cold working metals.
		3. Describe how forging affects the grain size and structure of metal.
5.	Heat straightening	1. Explain the basic theory of heat transfer and its affect on metals.
		2. Describe methods for heat straightening of different shapes and/or components.
		3. Demonstrate skills in heat straightening structural and plate members as assigned.
6.	Expansion and contraction	1. Describe the effects of expansion and contraction during welding procedures such as: a) heat effect on structure and mechanical properties b) direction and amount of expansion and contraction c) practical methods of distortion control

C. Lab Practices ..... 27 Hours

1.	Manual and semi automatic oxy-fuel cutting	1. Demonstrate the correct procedure for oxy-fuel cutting on: a) structural steel b) pipe c) vessels d) miscellaneous shapes

TOPIC	OBJECTIVES	SECOND PERIOD
	2. Pierce and cut a bolt hole to size.	
	3. Prepare materials with correct joint configuration.	
2. S.M.A.W./G.M.A.W.	1. Demonstrate the correct metal preparation and tacking procedures of components.	
3. Arc-air gouging	1. Describe and demonstrate carbon arc gouging.	

THIRD PERIOD TECHNICAL TRAINING
STRUCTURAL STEEL AND PLATE FITTER TRADE
COURSE OUTLINE

Due to the nature of the work of the Structural Steel and Plate Fitter, it is imperative that safety be taught on a continuous basis throughout the entirety of this course.

Special emphasis should be placed on weak areas of theory and practical areas which are evident from progressive tests and examinations administered throughout the course. The time required for such examinations and tests, shall be allowed for in each area of instruction.

TOPICS	OBJECTIVES **Upon successful completion of this unit the apprentice should be able to:**
SECTION ONE: LAYOUT, FITTING AND FABRICATION — 136 HOURS	
A. Layout — 16 Hours	
1. Parallel line development	1. Apply principles of parallel line development to layout the stretchout templates for true wye and lateral connections.
2. Radial line development	1. Layout templates for truncated frustum of cones.
	2. Layout templates for truncated frustum of pyramids with square and rectangular bases.
	3. Determine slant height (true length), included angle of stretchout, altitude to apex (when given frustum dimensions) and chord length for cones and frustums of cones.
	4. Layout templates for half sections of cones and pyramids.
3. Triangulation	1. Apply triangulation method of layout for pattern development of various square and rectangular to round transitions.
	2. Apply triangulation method of layout for pattern development of a "twisted square" transition.
	3. Layout half pattern templates for square and rectangular to round transitions and "twisted square" transitions.
	4. Layout pattern templates allowing for material thickness.
B. Fitting and Fabrication — 112 Hours	
1. Cones, hoppers, chutes and different shapes	1. Explain method of development and mark-up for cutting, forming and making allowance for plate thickness.
	2. Form transitions, conical shapes and cylinders using rolls and/or press brake.
	3. Fabricate transitions, conical shapes and cylinders.

		4. Explain the importance of proper joint preparation, welding procedure and welding sequence on fabricated components.
		5. Explain method of development and fitting procedures for channel, angle, flat bar and plate stiffeners, brackets and stools.
2.	Beams and columns	1. Prepare for welding and splicing beams and columns.
		2. Demonstrate ability to layout: a) opposite hand components (right/left) b) skewed connections
		3. Define proper fabrication procedures for welded and bolted structural connections.
3.	Girders, trusses and built-up sections	1. Explain the method of layout with emphasis on: a) laying out of materials b) developing and purpose of templates c) correct procedure for splicing materials d) building cambers into web plates e) developing bearing plate - expansion joints f) procedure for punching and stack drilling g) procedure for marking up for milling of chord ends
		2. Explain the procedure for: a) fitting of prefab sub-assemblies, sections b) developing and fitting of shop splicing or reaming, cambering of girders and trusses c) jig fitting units d) shop test assembly e) match marking f) floor system and bracing g) marking weld symbols
		3. Identify the different types of trusses.
		4. Describe the fabrication of trusses.
		5. State the reason for camber in trusses.
		6. Explain fabrication method to establish camber and maintain during welding.
		7. Identify and describe the various connections used in the fabrication of trusses.
4.	Tanks and containers	1. Identify and describe basic types and designs of tanks and containers utilised for petroleum, municipal, gas and food industries.
		2. Describe fabrication and material selection procedures.
		3. Describe tank fabrication procedures.
		4. Demonstrate basic tank fabrication procedures.

5. Pressure vessels	1. Demonstrate plate layout and forming with respect to squareness, allowances, edges, weld shrinkage and openings.
	2. Demonstrate layout and fit-up of external and internal components of a vessel.
	3. Describe fabrication procedures using clad steels.
	4. Identify and describe principle types of heat exchangers: sizing, standards and components.
	5. Describe heat exchanger rolling techniques and procedures.

C. General Fabrication Procedures and Shop Organisation.....8 Hours

Be able to understand the flow of material from supplier to customer including various company procedures to arrive at a "product" that meets the specifications.

1. Recommended fabrication procedures	1. Describe and demonstrate ability to estimate materials and take-off.
	2. Describe and demonstrate appropriate use of tools and special devices.
	3. Describe and demonstrate the recommended sequential procedures for a complete project.
2. Material flow through shop	1. Describe material storage and protection methods.
	2. Describe procedures for material yard preparation, feeding and transport to the shop machinery.
	3. Describe shop machinery and equipment layout.
	4. Describe production and quality control productivity innovative features.
	5. Describe shipping procedures.

SECTION TWO: .....DRAWING INTERPRETATION ..... 68 HOURS

A. Drawings .....36 Hours

1. Structural drawings.....16 Hours

	1. Explain the method of using working drawings.
	2. Interpret sections and sectional views.
	3. Identify sections for irregular objects.

4. Interpret:
   a) assembly drawings
   b) detail drawings
   c) graphic drawings

5. State the methods of dimensioning.

6. Identify and interpret revisions.

7. Interpret fabrication drawings with emphasis on:
   a) gauge out standing leg (GOSL)
   b) gauge
   c) standard and running dimensions
   d) transfer of work points
   e) fabrication practices
   f) stairs
   g) ladders
   h) trusses
   i) bridge girders

8. Demonstrate the ability to check gussets.

2. Engineering (design) ..... 6 Hours

1. Define common types of stress.

2. Identify and explain critical areas on trusses and beams.

3. Identify and explain the stress flow pattern on:
   a) beams
   b) columns
   c) stiffeners
   d) reinforcing pads

3. Advanced drawings for fabrication ..... 14 Hours

1. Interpret drawings.

2. Check for material.

3. Interpret material lists.

4. Interpret material size and title block.

5. Interpret truss drawings.

6. Interpret fabrication drawings for:
   a) structural steel components
   b) air pressure tanks
   c) vessels for refineries
   d) heat exchangers

B. Trigonometry.....8 Hours

The Mathematics delivered shall maintain a level applicable to the tradesman and have a definite relationship to functions experienced in the trade of Structural Steel and Plate Fitter. Both the Imperial and the Metric systems will be used where applicable and as circumstances dictate.

1. Define trigonometric functions and interpret trigonometric functions tables.
2. Use a scientific calculator to determine trigonometric functions.
3. Describe functions of complementary angles Sine, Cosine and Tangent function.
4. Determine an unknown:
   a) angle when two sides of a right triangle are known.
   b) side when an acute angle and one side of a right triangle are known.
5. Solve:
   a) practical application problems stated in word form
   b) problems related to layout and fabrication

C. Trade Applied Computation.....24 Hours

1. Estimating
   1. Calculate material quantities related to a study of a specific plan or drawing of:
      a) general material handling, equipment use, etc.
      b) material list
      c) fasteners
   2. Calculate labour cost from given man-hours for fabricated units or components.
   3. Compute total production costs including given percentages of shop and overhead costs.
2. Trade calculations
   1. Determine layout information for transition pieces by computation and compare the results with triangulation.
   2. Solve trade related problems involving:
      a) areas b) volumes
      c) capacities
      d) mass
      e) linear measurements

TOPIC	OBJECTIVES	THIRD PERIOD

SECTION THREE: ..... QUALITY CONTROL, CODES AND BUSINESS KNOWLEDGE ..... 36 HOURS

A. Quality Control (Q.C.) ..... 10 Hours

1. Steel inspection	1. Explain scope of quality control/assurance. (ISO - 9000)
	2. Discuss elements of a Q.C. system.
	3. Discuss why Q.C. is important.
	4. Identify method of Q.C. used by the Steel Fabrication Industry today to insure quality.
	5. Discuss relationship between Q.C. personnel and tradespersons.
	6. Define a: a) standard b) code c) specification d) procedure
	7. Describe the difference between a standard and code.
	8. Discuss functions of standards and codes.
	9. Define scope of Q.C. inspection.

B. Inspection Methods ..... 6 Hours

	1. Discuss various "Stages of Inspection".
	2. Describe typical non conformance's to identify during each stage of inspection.
	3. Discuss the economic value of each stage of inspection.
	4. Discuss visual inspection.
	5. Evaluate a typical visual inspection checklist.
	6. Identify uses of various templates and gauges used for visual inspection: a) bending templates b) marking templates c) radius gauges d) weld gauges (root opening, bevels, leg size and effective throat) e) paint gauges
	7. Identify errors in reporting procedures.
	8. Interpret inspection reports.

	9. Describe and observe each method of: a) N.D.T. b) D.T.
	10. Describe methods of inspecting welds.

C. Protective Coatings for Steel.....4 Hours

1. Coatings	1. Describe various protective coatings applied to steel.
	2. Discuss what rusting is and what causes it.
	3. Preparation of metals for removal of mill scale.
	4. Discuss paint as a protector and methods of inspecting it.
	5. Discuss galvanising of steel and preparation of materials to be coated.
	6. Describe other methods of coating steel.
2. Galvanising	1. Define what galvanising is.
	2. Discuss how it protects steel.
	3. Describe how it is applied to steel.
	4. Describe the procedures for preparing steel assemblies for galvanising.
	5. Identify what to look for when inspecting a galvanised product.

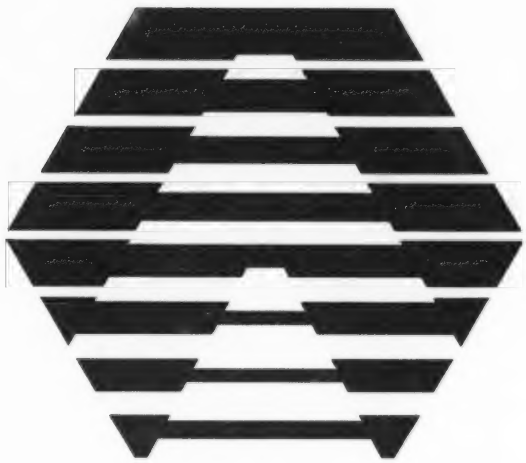
D. Codes and Standards.....8 Hours

	1. Interpret the A.P.I. code as it relates to steel fabrication.
	2. Interpret the C.S.A. code as it applies to steel fabrication. (C.W.B. W47.1, W59)
	3. Interpret the C.I.S.C. code of standard practice.
	4. Interpret the A.S.M.E. code as it applies to steel fabrication of: a) fitting of heads to shells b) fitting shell sections
	5. Identify ISO - 9000.

E. Business Knowledge .....8 Hours

1. Reports and time cards	1. Demonstrate the correct procedure for developing reports and filling in time cards.

		2. Interpret written orders. 3. Interpret requests and conditions.
2.	Responsibilities	1. Explain the responsibilities a Structural Steel and Plate Fitter has to: a) oneself, fellow workers and general public b) the foreman and employer c) Apprenticeship and Trade Certification d) provincial labour standards e) company policies and procedures
3.	Public relations	1. Explain the relation a Structural Steel and Plate Fitter has in: a) co-operation with allied trades b) co-ordination with other trade functions c) recognition of work related problems d) consideration of public needs
4.	Guest speakers	1. Guest speakers may be of the training establishment's choice and may include trade experts or product representatives. a) W.C.B. b) O.H. & S. c) Metal Fabricator's Health and Safety d) Company representatives (Q.A., production superintendent, safety co-ordinator, owners, job co-ordinator, estimator) e) Rolling mill representatives f) C.W.B. and A.B.S.A. representatives g) Personal protection equipment supplier



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